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THE ROLE OF MAN ON THE CHANGING FISHERY POTENTIALS OF LAKES VICTORIA AND KYOGA

BY:

A. W. Kudhongania
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INTRODUCTION

Approximately 1/6th of the surface area of Uganda is covered by water. The total water surface area of about 70,000 km^2 includes both the large and small systems of lakes and rivers. Among tho lakes, the Uganda partion of Lake Victoria (30,000 km^2) and Lake Kyoga (3,400 km^2) together form tho, major component of Uganda's fishery resources. These two lakes are connected by the Victoria Nile and their fish faunas, described as Victorian (Greenwood, 1966) are closely similar. The main difference in their itchthyofaunas is the large number of haplochromine species in Lake Victoria which devoloped through explosive endemic speciation (Greenwood, 1958).

The fisheries of Lakes Kyoga and Victoria were, until tho 1960's and the 1970's respectively, dominated by tilapiine and haploohromino cichlids. These were largely herbivores and detritus feeders. Fisheries based on such short faad chains are, ecologically the most efficient (Goldman and Horne, 1983). The exploratory survey conducted on Lake Victoria between 1969 and 1971 suggested that the cichlids constituted more than 85% of the total itchthyomass (Kudhongania, 1972). But a number of exotic fish species, including the herbivorous Oroochromis niloticus and the catholic, voracious predator, Lates niloticus, were introduced into the lucrative, slowly evolving traditional fisheries of Lakes Victoria and Kyoga. Following the establishmont of the introduced fish species, together with other factors, tho population dynamics and the commercial fisheries of tho two lakes were groatly modified and are now closely tied to L. niloticus and O. niloticus. Many of the original fish species have doclined or almost disappeared, leading to a shift to fewer target species for exploitation. How tho fewer targot spocies would continue to influence the mode and tempo of tho performance of the fisheries within the changing ecosystems is a matter of public and international concern.

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The drastic transitional patterns in Lakes Victoria and Kyoga fisheries illustrate the fragility of fish communities to biotic and abiotic undesirable changes even though the degree, mode and sequence of response by the various fish stocks may have been different.

The Fishery Potentials of Lakes Victoria and Kyoga

A number of factors co-act to encourage high fish yield potentials from these two lakes. Lakes Victoria and Kyoga are comparatively shallow. Lake Victoria has a mean depth of about 40 m while Lake Kyoga has a maximum depth of only around 5 m. Shallow lakes are potentially more productive than deep lakes, if other factors were to remain the same.

Both lakes have extremely irregular shores. This makes their shallow water/land boundries very extensive. The terrestrial/aquatic boundry (together with the littoral zone, fringing swamps, affluent river systems) is a highly productive zone which comprises terrestrial and aquatic components of production. Its high nutrient load makes it rich in plankton and invertebrates which, in turn, encourage high fish production.

From the law of latitudes, biological productivity and diversity in tropical lakes would be expected to be high. The high tropical temperatures, intense illumination and prolonged growing seasons impart high productivity values to the systems. The photosynthetic activity in Lake Victoria, for instance, is relatively high (Talling, 1965). The greater diversity of fish species at low than at high latitudes appears to be the case both in the stable conditions of lakes and in the seasonally fluctuating conditions in rivers (Lowe-McConnell, 1969). The fish yield from tropical African Lakes is about ten times the yield from north-temperate lakes (Henderson and Welcomme, 1974).

In terms of fish yields, Lake Kyoga (3,400 km^2) is believed to be capable of producing 150,000 tons annually while the Uganda sector of Lake Victoria (30,000 km^2) is estimated to have a potential yield of 180,000 tons (Welcomme, 1972). The two lakes are important not only for their lucrative multispecies fisheries but also for the evolutionary significance of the Lake Victoria cichlids to the world scientific community (Jackson, 1973).

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man's contribution to the Dramatic changes in the Fishorios

The structure of an aquatic system is described by its morphometry, drainage basin, the distribution of physical properties (light, heat, etc), chemical components and biota (Goldman and Horne, op. cit.). Certain qualitative and "quantitative factors which influence the structures of Lakes Victoria and Kyoga have been modified by the impact of man. The impact is the sum of the direct and indirect consequencies of unguided activities.

i) Changes in the fishing gears and intunsity

Tho traditional fishing gears were mainly basket traps, hooks and papyrus seino nuts which did little damago to tho stocks. As the fishing industry developed other forms of fishing came into use. These includod the introduction of thu flux gill-nots, the synthentic fibre gill-nets, tho boach seinos, tho usc of tho outboard engines, tho illogal usc of tho 'tycoon', and quito rcently the cast nets, and the scoop and ring-nots for Rastrinoobola (Enqraulisypris). On Lako Victoria limitod trawl fishing has boon reported.

The changos in the fishing gears came about partly as a need to develop tho fishing industry by more effective fishing methods and partly because tho multispocios fisherios of Lakes Victoria and Kyoga require differont varieties of fishing goars for tho equitable exploitation of tho availablo resourcos. Although the dovolopments in the multiplo fishing gears producod positivo changus in catch and specios composition thoro havo boen side affects with nogative consoquoncos. As an examplo tho beach soine is officiont in exploiting the haplochromine taxon of Lake Victoria, but it damages the broeding, fooding and nursery grounds of othor fish (o.g. tilapinos):

In addition to tho increaso in tho types and numbors of fishing gears, the number of fishormon has also been incroasing as a result of the National deffiorgraphic trends and omploymont noods. The sumo of those two devolopments has contributod significantly to tho changos in tho dynamcis of the fisheries.

ii) Dostruction of the crocodiles and floating islands

Floating islands and crocodilu populations were a common foaturo in cortain areas of Lakos Victoria and Kyoga. Through tho years tho

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crocodiles were hunted for their skins and because they destroyed the fishing gears. much of the aquatic vegetation and floating islands, for limiting the fishable areas, were also cleared. Those improvements have had the insidious consequence of altering the ecosystem structure and dynamics. Clearing the vegetation lead to the loss of breeding and nursery grounds and, together with the reduction in crocodile count, permitted the increase in fishing intensity.

iii) Indirect human perturbations along the lake shores

The area around Lake Victoria is highly populated due to the rainfall regime favourable for agriculture, and the proximity of the lake is convenient to urban and industrial developments. The same could be said of Lake Kyoga although to a lesser magnitude.

Human perturbations along the lake shores may arise from industrial effluents (chemical and thermal), vegetation clearing which may lead to silting (physical and chemical effects), agro-chemicals, petroleum oils, sewage and refuse disposal systems, etc. The effects of these are the least studied mainly due to their potential conflict of interests. But they have their direct hazards (e.g. poisoned biota) and may lead to eutrohication (Bugonyi, 1984).

Eutrophication alters the physical, chemical and biological characteristics of the aquatic systems (Goldman and Horne, op. cit.), and cultural outrophication is more accelerated than natural eutrophication (Smith, 1972). Apart from the direct effects, there are the indirect consequences of Eutrophication which are more profound (Numarin, 1972).

Lakes Victoria and Kyoga, being relatively shallow, respond rapidly to allochthonous inputs which readily blend into the aquatic systems. The impact normally begins within the inshore areas which are fundamental instruments in ecosystem dynamics particularly with regard to the recruitment processes (Kudhongania and Twongo, 1985).

The area supports various life-history stages of a number of fish species, feeding at different trophic levels.

Affluent river systoms within the area are ossontial for the mandatory bohaviour of anadromous fish spocios.

The spocies of tho traditional lucratiVD fishory, with short food chains, are moro or loss oligobathic(Kudhongania and Cordone, Ope cit.)

Sinco changes in tho dynamics of a fishory often proc8od in association, man's activities along tho lake shores have a wide potontial range of modifying tho fisheries especially in the absonco of sound strategies for the multidisciplinary use of the environment. (The need for integration of the various uses for the environmen)

(iv) Lack of sound manaqemont stratoqies'

Fishery management involves tho application of measuros aimed at sustaining and/or improving' on the qualitativo and quantitative socio-economic bonefits from a given fishery. The viability of management decisions dopends on tho integrity of the scientific knowledge used, and on tho timeliness and success of their implemontation.

There has boen no sound management schomes for Lakes Victoria and Kyoga sinco the gillnet mesh-size restriction on Lako Victoria was repealed in 1956. This lack arose from the difficulty in onforcing tho necessary regulatory measures and in order to avoid tho w$ight of conflicting interests. The inadequacy of control measures enablod the undesirable fishing practicos and ecosystem disturbances to grow untrammellod•

(v) Introduction of exotic fish species, like the Nile perch

Nile perch elates niloticus) is widosproad in Africa. It is a native of the Nile river from Lake Albert to tho delta region and occurs in the Senegal, Niger **a,d** Congo river systems. ''it is prosont in Lakes Tanganyika, Chad, Volta and Turkana (Rudolr). But it was absont in lakes Victoria and Kyoga until its introduction there amidst a raspy debato for and against tho mOVG.

Lates was introducod into Lako Victoria, in the oarly 1960's, as a development strategy to convert tho littlu exploited haplochromino stocks into Nile perch flesh. Prior to that Latos had boon introducod into lake Kyoga,

which had similar itchthyofauna, as a test experiment. But tho Nile porch was precipitately plantod in Lako Victoria boforu the expericment on Lake Kyoga had been assessed. The phonomenon of Nile porch in Lakes Victoria and Kyoga clearly demonstrate the prudence of allowing enough time for scientific invostigations.

Among tho consoquencies which were not considered before hand included:-

The resilience of the traditional target stocks to the trophic interactiohs modified by Lates.

The consoquoncies of interspecific competition betweon tho exotic Lates (a cosmopolitan voracious predator) and the endomic prodators Bagrus, Protoptorus and Clariss.

The transitional patterns of tho usually dolicate oxploited predator/ prey systems, in the added presenco of Lates.

Whether community enorgy flow would not bo upset by ovcr-grazing key trophic levels.

Besides lates a number of tilapiino spocies, including Oroochromis niloticus (which is tho largost herbivorous cichlid in this region) were introduced into Lakes Kyoga and Victoria. Tho successful establishment of O. niloticus and L. niloticus, which co-oxist inthoir endemic habitat of Lako Albert, followed a similar sequonco in both lakes.

The mode of Transition in the Fishorios

Current trends in the biogenic capacity and in population dynamics of the fisheries of Lakes Victoria and Kyoga havo bocn directed by a combination of man-made factors. Theso include: intensified fishing regimes, cultural eutrophication, introduction of Lates and *Q. niloticus*, and lack of competent management strategies. Those and othGr factors drive the transitional patterns of thG fisheries. Thoro are dramatic changes in predation pressure, trophic structure, spatial distribution, species relative abundance and in the annual landings. It is not yet clear whuthor tho new equilibrium level would be desirable or not. The most significant changos are:-

(i) The predominance of the Gxotic Lates niloticus and Oreochromis niloticus in the catch.

In Lake Kyoga the total landings increased from 4,500 tons in 1956 to about 110,000 tons since 1970. A few yoarsago, the most abundant fish in the main lake were O. niloticus, Latos and Rastrineobola (Engraulicypris) argentea. Lates and O. niloticus contributod more than 80% of the total catch but right now even these species particularly tho Nile porch are doclining rapidly (Dr. Twongo, pers. com.).

In Lake Victoria Lates and O. niloticus together constituted less than 0.3% of tho total itchyomoss during the 1969/71 stock assossment survey (Kudhongania & Cordone, 1974) and in 1978 Lates formed about 5% of tho commercial landings. By 1982 Lates constituted more than 60% of tho annual catchos.

(ii) The doclino in tho traditional commercial fish spocios.

The traditional fish species in Lako Kyoga contributo less than 20% of tho fish yield. The fow of those specios still present are confined to the inshore and around areas with aquatic macrophytos (Ogutu-Ohwayo, 1985).

The traditional fishery of tilapiinos, Bagrus, Clarias, Protoptorus haplochromines and a number of anadromous fish specios (e.g. LaboD, Barbus, etc) on Lake Victoria constituted up to more than 90% of tho total harvest. But the same species now contribute less than 20% of the catch. Tho increase in Nile perch has been proportional to the docline in catch of the haplochromines. Haplochromines formed more than 80% of the estimated total biomass in Lake Victoria and are the main pray for Lates. The use of large mesh-size gillnets to capture Latos is likely to bo rosponsible for the sporadic slight increases in catches of the endomic tilapiinos and some anadromous spocies (Ssentongo and Welcomme, 1985).

(iii) The developing fishery of Rastrineobola argentea (Mukene)

Rastrineobola argentea is a small, pelagic, zooplanktivorous cyprinid. Although it was present in tho traditional faunas of Lakes Victoria and Kyoga,

it formed a conservative component of the commercial landings. In recent years Rastrineobola catches have increased significantly. This cyprinid appears to co-exist with Nile perch in both Lakes Victoria and Kyoga. Although it forms the main pray for adult Nile perch in Lake Kyoga (Ogutu-Ohwayo, op. cit.), and for certain age-groups in Lake Victoria (Acero, 1985), there are suggestions that the Rastrinoobola fishery would continue to expand.

Summary

The traditional lucrative fisheries of Lakes Victoria and Kyoga were based on similar multispecies itchthyofaunes. Man's activities on and around these lakes have both directly and indirectly assisted to modify the natural trends and components of the commercial fisheries. The exotic L. niloticuB and Q. nilotious together with the native R. argentea form the major component of current commercial landings. The total catches are higher but it is not yet clear whether the increase would endure --- given the fragility of predator/prey systems. The trophodynamics are still modifying and it is not certain how ecosystem function would be influenced. It is, therefore, prudent and desirable to undertake appropriate research investigations in order to guide the multiobjective activities of man on these lakes.

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References

Acere, T.O. (1985): Observations on the biology, age, growth; maturity and sexuality of Nile perch, Lates niloticus (Linne), and the growth of its fishery in the northern waters of Lake IVictoria. FAD Fishery Report No. 335: pp. 42-61.

Bugenyi, F.W.B. (1984): Potential aquatic Environmental Hazards of agro-based chemicals and practices in a Devoloping Country, Uganda. Proc. Int. Conf. Env. HaZe AgrochGm. Vol. 1: 461-473.

Fish, G.R. (1956): Some aspects of the respiration of six species of fish from Uganda. J. Exp. *Biol.* 33: 186-95.

Goldman, C.R. and A.J. Horne (1983): Limnology McGraw-Hill International Book Company.

Greenwood, P.H. (1958): Evolution and Speciation in the Haplochromis Fauna (Pisces, Cichlidae) of Lake Victoria. Proc. 15th Int. Congr. Zool. 147-149.

Greenwood, P.H. (1966): The Fishes of Uganda. The Uganda Society, Kampala.

Henderson, H.F. and R.L. Welcomme (1974): The relationship of yield to morpho-edaphic index and numbers of fishermen iri African inland fisheries. CIFA/OP 1, FAO Rome.

Jackson, P,B.N. (1973): The African Great Lakes: Food sourCD and World Treasure. Biological conservation, 5(4): pp. 303-304.

Kudhongsnia, A.W. (1972): Past trends and recent Rosoarch in the fisheries of Lake Victoria in relation to possible future developments. Afr. J. Trap. Hydrobiol. Fish. Special Issuo II pp. 93-106.

Kudhonganio., A.W. and A.J. Cordone (1974): Batho-spatial distribution patterns and biomass estimates of tho major demorsal fishes in Lake Victoria. Afr. J. Trop. Hydr6biol. Fish. Vol. 3, No.1: 15-31.

Kudhongania, A.W. and T. Twongo (1985): Some considerations for research and management of tho Lake Victoria fisheries. FAD Fishorios Report No. 335 pp. 139-142.

Lowe-McConnell, R.H. (1969): Spociation in tropical freshwater fishos. BioI. J. Linn. Soc. 1: 51-75.

.../10

Numann, W. (1972): The Bodensee: Effects of exploitation and eutrophication on the salmonid community. J. Fish. Res. Bd. Canada. 29: 833-847.

Ogutu-Ohwayo, R. (1985): The effects of predation by Nile porch, Lates niloticus (Linne) introduced into (Uganda) in relation to the fisheries of Lake Kyoga and Lake Victoria. fAD Fisheries Report No. 335. pp. 18-41.

Smith, M. (1972): Great Lakes; Effects of exploitation, outrophication and fish introductions on the salmonid Community. J. Fish. Res. Bd. Canada 29:

Ssentongo, C.lli. and R.L. tUelcomme (1985): Past history and current trends in the Fisheries of Lake Victoria. FAO Fisheries Report No. 335 pp. 123-138.

stoneman, J. and J.F. Rogers (1970): Increase in fish production achieved by stocking exotic species (Lake Kyoga, Uganda). Occas. Paper, Fish. Dep. Uganda' (3): 16-19.

Talling, J.F. ('965): The photosynthetic activity of phytoplankton in East African lakes. Int. Revue Ces. Hydrobiol. 50 (1): 1-32.

Talling, J.F. <'966): The' annual cycle of stratification and phytoplankton growth in Lake Victoria (East Africa). Int. Rev. Gesant. Hydrobiol. 51: 545-621